

ANNESSO TECNICO 6.

Elaborati di calcolo Scenari incidentali ragionevolmente credibili

Ipotesi N. 15

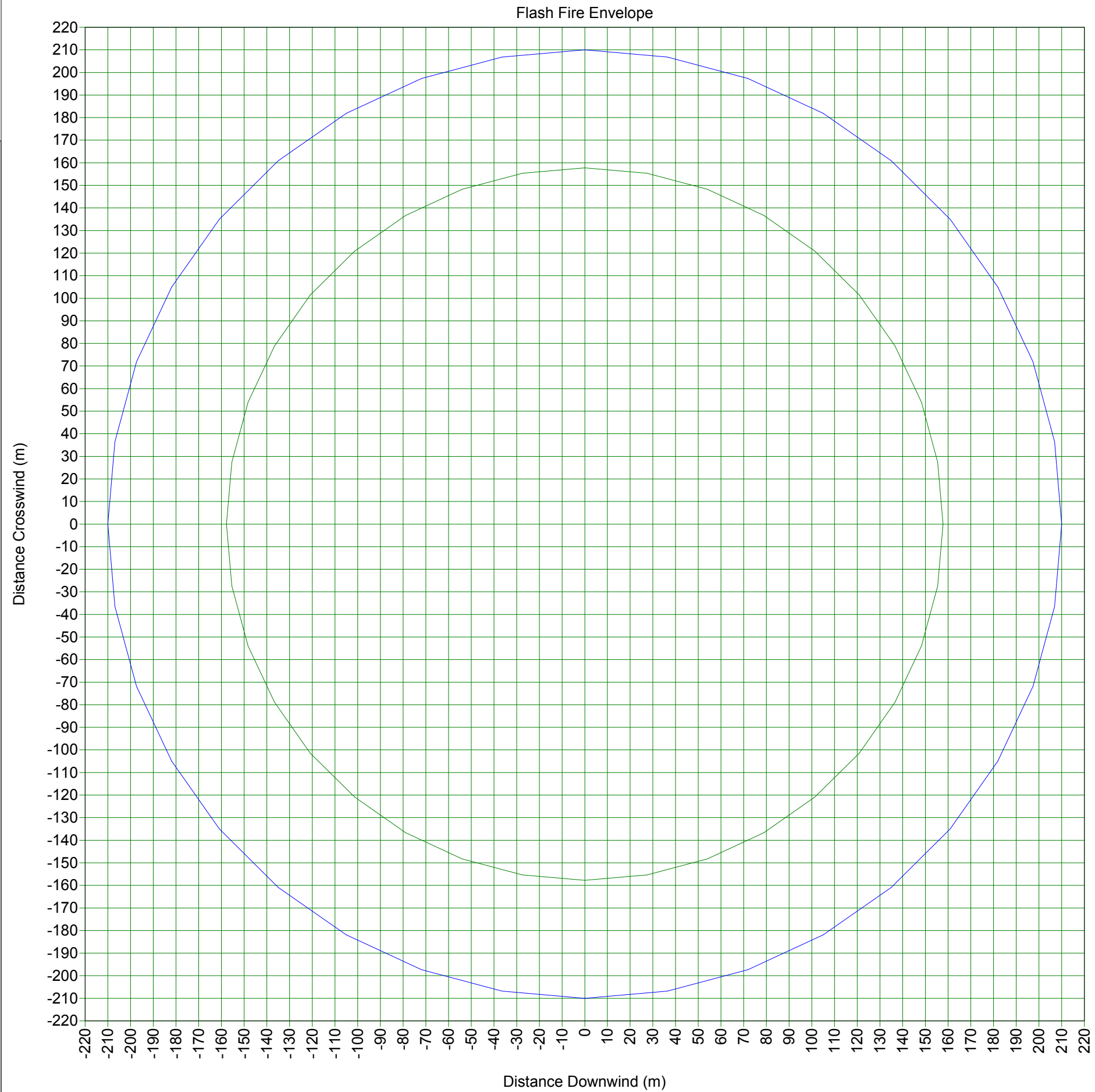
TRR S.r.l.

Il Direttore Generale

Ing. Alfredo Romano

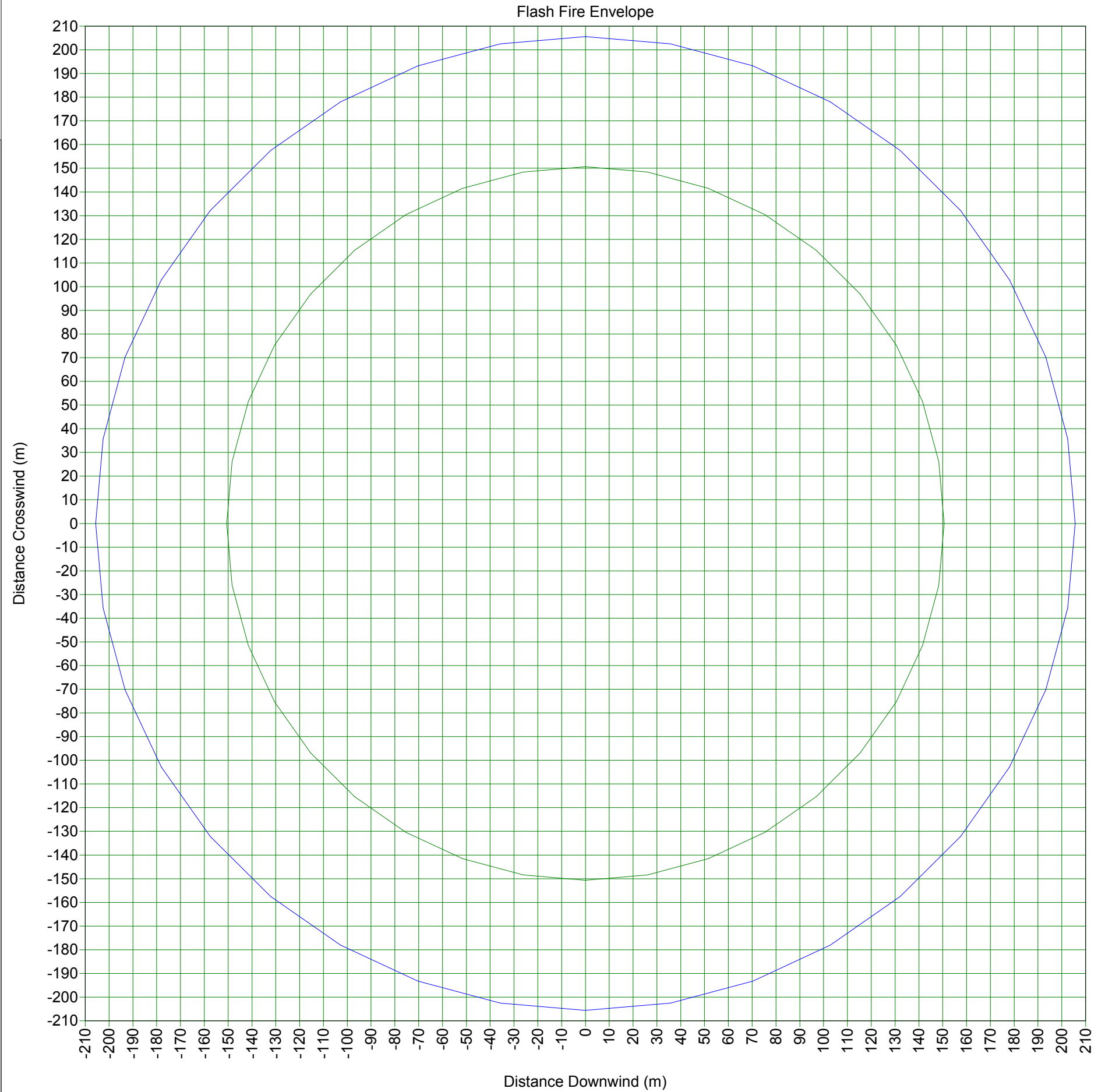

Study Folder: 70977-Fase
2-lp15
Audit No: 65808
Model: 140mm
Weather: Category 5/D
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



Study Folder: 70977-Fase
2-lp15
Audit No: 65808
Model: 140mm
Weather: Category 2/F
Material: METHANE
Concentration

— 2.2e+004 ppm
— 4.4e+004 ppm



JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip15

Unique Audit Number: 65.808



Phast 6.6



70977-Fase 2-Ip15



Misura Fiscale - Erogazione

140mm

Base Case

Data



Weather: Global Weathers\Category 2/F

Speed: 2,00 m/s

Stability: F

\\70977-Fase 2-Ip15\Misura Fiscale - Erogazione\140mm

Flame Data

User-Defined Quantities

Model Correlation Type	API
Material	METHANE
Ambient Temperature	25,00 degC
Ambient Relative Humidity	0,75 fraction
Ambient Wind Speed	2,00 m/s
Maximum Exposure Duration	20,00 s
Elevation	1,00 m
Expanded Temperature	-1,82 degC
Release Rate	183,56 kg/s

Input

Output

Flame Emissive Power	139,46 kW/m2
Fraction of Emissivity	0,15 fraction
Expanded Radius	0,40 m
Jet Velocity	500,00 m/s
Flame Length	189,29 m
Maximum Flame Radius	11,77 m

Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,40	90,00
21,03	1,00	4,52	90,00
42,06	1,00	7,48	90,00
63,10	1,00	9,59	90,00
84,13	1,00	10,99	90,00
105,16	1,00	11,69	90,00
126,19	1,00	11,65	90,00
147,23	1,00	10,70	90,00
168,26	1,00	8,37	90,00
189,29	1,00	0,00	90,00

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip15

Unique Audit Number: 65.808



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Radiation Intensity Ellipse

User-Defined Quantities

Observer Inclination	Variable	deg
Observer Orientation	Variable	deg
Exposure Duration	20,00	s
Effect Height	0,00	m

Calculated Quantities

Incident Radiation Level:	3,00	kW/m2
Lethality Level	0,00	%
View Factor	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	110,81	m
Crosswind semi-axis (B)	159,99	m
Offset Ratio (D)	0,95	
Effect Distance	216,97	m
Area	55.695,05	m2

Incident Radiation Level:	5,00	kW/m2
Lethality Level	0,00	%
View Factor	0,04	
Dose Level	1.709.490,54	(W/m2)^Probit N.s

Downwind semi-axis (A)	104,26	m
Crosswind semi-axis (B)	121,48	m
Offset Ratio (D)	0,98	
Effect Distance	205,93	m
Area	39.790,79	m2

Incident Radiation Level:	7,00	kW/m2
Lethality Level	0,02	%
View Factor	0,05	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	101,01	m
Crosswind semi-axis (B)	100,15	m
Offset Ratio (D)	0,98	
Effect Distance	200,21	m
Area	31.779,07	m2

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Study Folder: 70977-Fase 2-Ip15

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Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,09	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	96,42	m
Crosswind semi-axis (B)	69,56	m
Offset Ratio (D)	0,99	
Effect Distance	191,87	m
Area	21.071,63	m2

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Study Folder: 70977-Fase 2-Ip15

Unique Audit Number: 65.808

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Radiation Distance

User-Defined Quantities

Maximum Distance	500,00	m
Angle from Wind Direction	0,00	deg
Height above Origin	0,00	m
Observer Inclination	Variable	deg
Observer Orientation	Variable	deg

Calculated Quantities

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
0,00			39,61		
10,20			139,46		
20,41			139,46		
30,61			139,46		
40,82			139,46		
51,02			139,46		
61,22			139,46		
71,43			139,46		
81,63			139,46		
91,84			139,46		
102,04			139,46		
112,24			139,46		
122,45			139,46		
132,65			139,46		
142,86			139,46		
153,06			139,46		
163,27			139,46		
173,47			139,46		
183,67			139,46		
193,88			10,89		
204,08			5,55		
214,29			3,31		
224,49			2,18		
234,69			1,54		
244,90			1,16		
255,10			0,92		
265,31			0,76		
275,51			0,64		
285,71			0,54		
295,92			0,46		
306,12			0,40		
316,33			0,35		
326,53			0,31		
336,73			0,27		
346,94			0,25		
357,14			0,22		
367,35			0,20		

JET FIRE REPORT

Unique Audit Number: 65.808



Study Folder: 70977-Fase 2-Ip15

Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,18		
387,76			0,16		
397,96			0,15		
408,16			0,14		
418,37			0,13		
428,57			0,12		
438,78			0,11		
448,98			0,10		
459,18			0,10		
469,39			0,09		
479,59			0,09		
489,80			0,08		
500,00			0,08		



Weather: Global Weathers\Category 5/D

Speed: 5,00

m/s

Stability: D

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Flame Data

User-Defined Quantities

Model Correlation Type	API	
Material	METHANE	
Ambient Temperature	25,00	degC
Ambient Relative Humidity	0,75	fraction
Ambient Wind Speed	5,00	m/s
Maximum Exposure Duration	20,00	s
Elevation	1,00	m
Expanded Temperature	-1,82	degC
Release Rate	183,56	kg/s

	Input	Output
Flame Emissive Power		139,46 kW/m2
Fraction of Emissivity		0,15 fraction
Expanded Radius		0,40 m
Jet Velocity	500,00	500,00 m/s
Flame Length		189,29 m
Maximum Flame Radius		11,77 m

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip15

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Phast 6.6



Flame Co-ordinates

X	Z	R	Phi
m	m	m	deg
0,00	1,00	0,40	90,00
21,03	1,00	4,52	90,00
42,06	1,00	7,48	90,00
63,10	1,00	9,59	90,00
84,13	1,00	10,99	90,00
105,16	1,00	11,69	90,00
126,19	1,00	11,65	90,00
147,23	1,00	10,70	90,00
168,26	1,00	8,37	90,00
189,29	1,00	0,00	90,00

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Study Folder: 70977-Fase 2-Ip15

Unique Audit Number: 65.808



Phast 6.6

Radiation Intensity Ellipse

User-Defined Quantities

Observer Inclination	Variable	deg
Observer Orientation	Variable	deg
Exposure Duration	20,00	s
Effect Height	0,00	m

Calculated Quantities

Incident Radiation Level:	3,00	kW/m2
Lethality Level	0,00	%
View Factor	0,02	
Dose Level	865.118,83	(W/m2)^Probit N.s

Downwind semi-axis (A)	110,81	m
Crosswind semi-axis (B)	159,99	m
Offset Ratio (D)	0,95	
Effect Distance	216,97	m
Area	55.695,05	m2

Incident Radiation Level:	5,00	kW/m2
Lethality Level	0,00	%
View Factor	0,04	
Dose Level	1.709.490,54	(W/m2)^Probit N.s

Downwind semi-axis (A)	104,26	m
Crosswind semi-axis (B)	121,48	m
Offset Ratio (D)	0,98	
Effect Distance	205,93	m
Area	39.790,79	m2

Incident Radiation Level:	7,00	kW/m2
Lethality Level	0,02	%
View Factor	0,05	
Dose Level	2.677.313,40	(W/m2)^Probit N.s

Downwind semi-axis (A)	101,01	m
Crosswind semi-axis (B)	100,15	m
Offset Ratio (D)	0,98	
Effect Distance	200,21	m
Area	31.779,07	m2

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Study Folder: 70977-Fase 2-Ip15

Phast 6.6

Incident Radiation Level:	12,50	kW/m2
Lethality Level	6,53	%
View Factor	0,09	
Dose Level	5.800.161,90	(W/m2)^Probit N.s
Downwind semi-axis (A)	96,42	m
Crosswind semi-axis (B)	69,56	m
Offset Ratio (D)	0,99	
Effect Distance	191,87	m
Area	21.071,63	m2

JET FIRE REPORT

Study Folder: 70977-Fase 2-Ip15

Unique Audit Number: 65.808

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Radiation Distance

User-Defined Quantities

Maximum Distance	500,00	m
Angle from Wind Direction	0,00	deg
Height above Origin	0,00	m
Observer Inclination	Variable	deg
Observer Orientation	Variable	deg

Calculated Quantities

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
0,00			39,61		
10,20			139,46		
20,41			139,46		
30,61			139,46		
40,82			139,46		
51,02			139,46		
61,22			139,46		
71,43			139,46		
81,63			139,46		
91,84			139,46		
102,04			139,46		
112,24			139,46		
122,45			139,46		
132,65			139,46		
142,86			139,46		
153,06			139,46		
163,27			139,46		
173,47			139,46		
183,67			139,46		
193,88			10,89		
204,08			5,55		
214,29			3,31		
224,49			2,18		
234,69			1,54		
244,90			1,16		
255,10			0,92		
265,31			0,76		
275,51			0,64		
285,71			0,54		
295,92			0,46		
306,12			0,40		
316,33			0,35		
326,53			0,31		
336,73			0,27		
346,94			0,25		
357,14			0,22		
367,35			0,20		

JET FIRE REPORT

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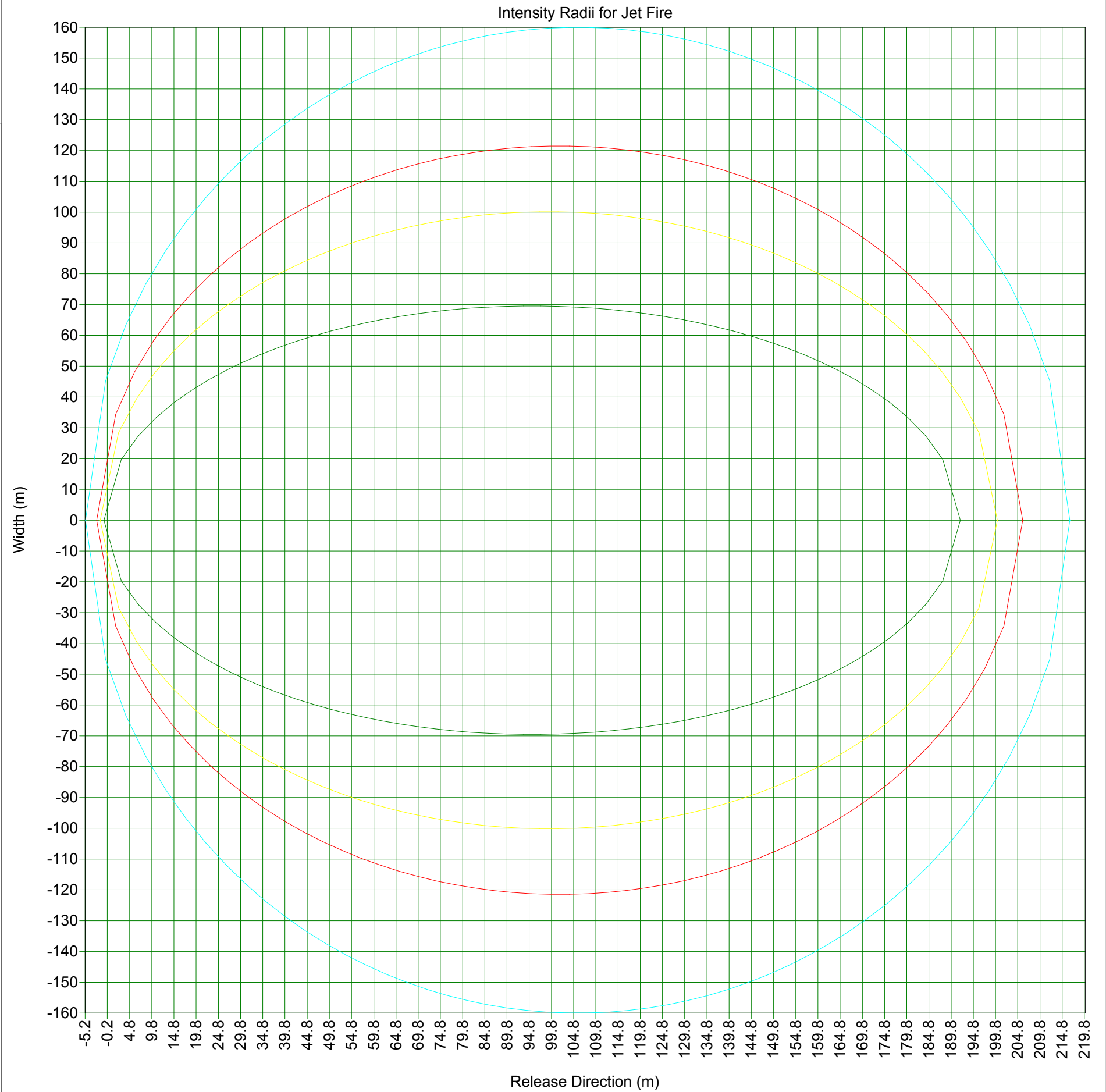
Study Folder: 70977-Fase 2-Ip15

Phast 6.6

X Coordinates m	Y Coordinates m	Z Coordinates m	Incident Radiation kW/m2	Lethality Level %	View Factor
377,55			0,18		
387,76			0,16		
397,96			0,15		
408,16			0,14		
418,37			0,13		
428,57			0,12		
438,78			0,11		
448,98			0,10		
459,18			0,10		
469,39			0,09		
479,59			0,09		
489,80			0,08		
500,00			0,08		

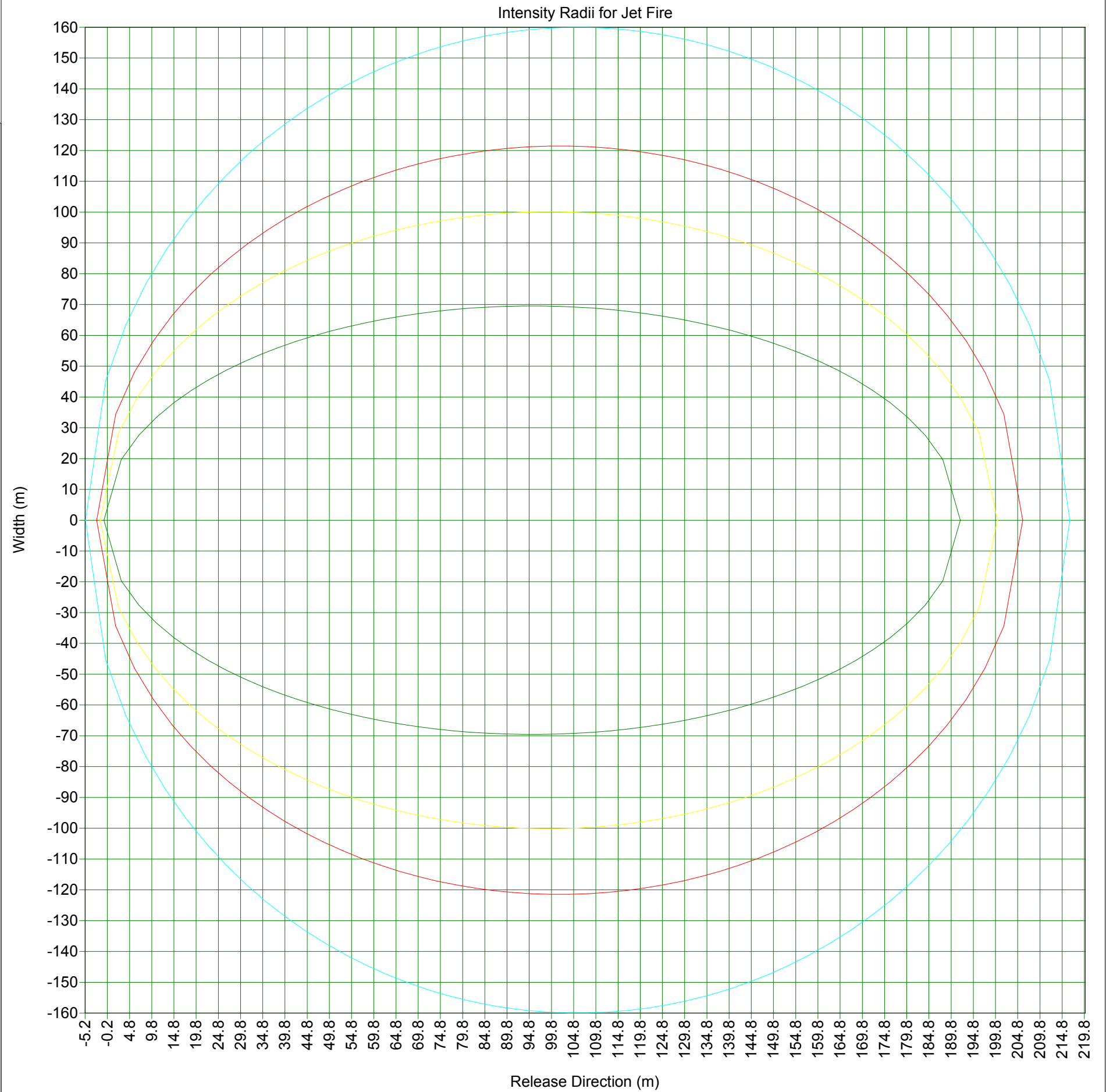
Study Folder: 70977-Fase
2-lp15
Audit No: 65808
Model: 140mm
Weather: Category 5/D
Material: METHANE

- Ellipse @12.5 kW/m2
- Ellipse @7 kW/m2
- Ellipse @5 kW/m2
- Ellipse @3 kW/m2



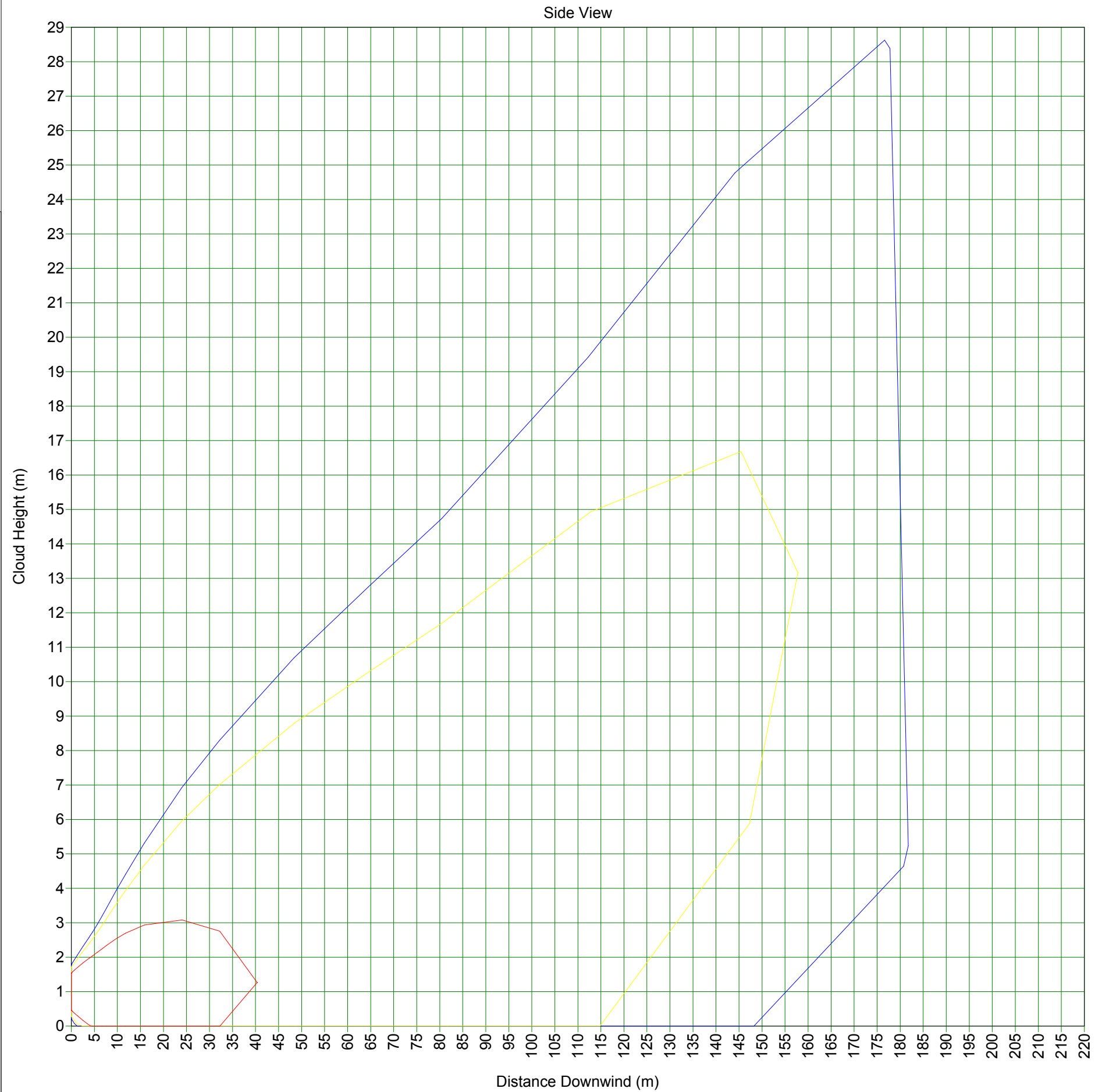
Study Folder: 70977-Fase
2-lp15
Audit No: 65808
Model: 140mm
Weather: Category 2/F
Material: METHANE

- Ellipse @12.5 kW/m2
- Ellipse @7 kW/m2
- Ellipse @5 kW/m2
- Ellipse @3 kW/m2



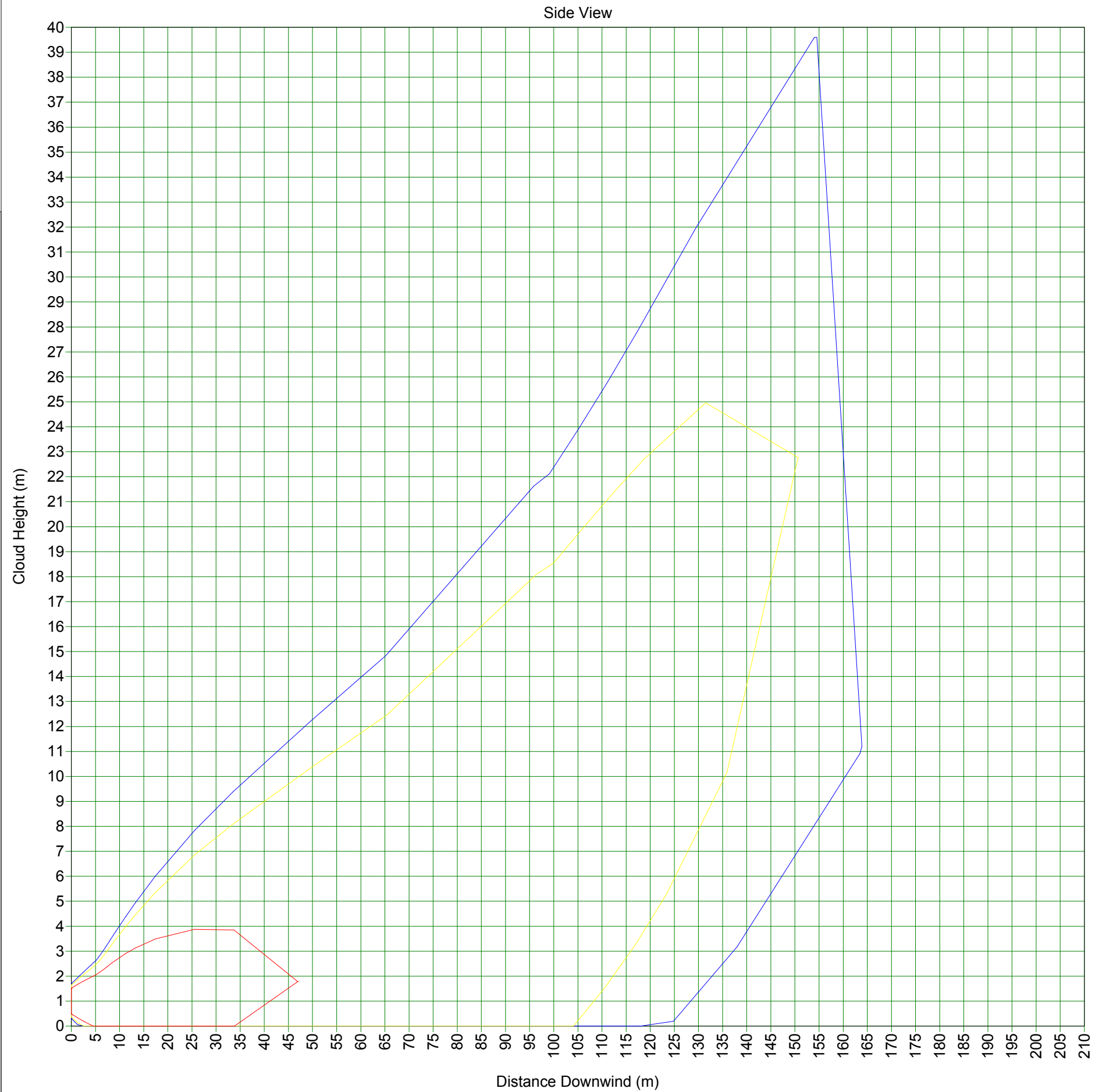
Study Folder: 70977-Fase
2-lp15
Audit No: 65808
Model: 140mm
Weather: Category 5/D
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 12.89 s

— 2.2e+004 ppm
— 4.4e+004 ppm
— 1.65e+005 ppm



Study Folder: 70977-Fase
2-lp15
Audit No: 65808
Model: 140mm
Weather: Category 2/F
Material: METHANE
Averaging Time:
Flammable(18.75 s)
C/L Offset: 0 m
Concentration
Time: 14.71 s

— 2.2e+004 ppm
— 4.4e+004 ppm
— 1.65e+005 ppm



SUMMARY REPORT

Unique Audit Number: 65.808



Study Folder: 70977-Fase 2-Ip15

Phast 6.6



70977-Fase 2-Ip15



Misura Fiscale - Erogazione

140mm

Base Case

CASE Name: Data

Path: \70977-Fase 2-Ip15\Misura Fiscale - Erogazione\140mm

User-Defined Data

Material

Material Identifier	METHANE
Type of Vessel	Pressurized Gas
Pressure Specification	Pressure specified
Storage Pressure - gauge	70 bar
Temperature	50 degC

Scenario

Scenario Type	Long Pipeline
Phase to be Released	Vapor
Building Wake Effect	None

Pipe

Internal Diameter	700 mm
Line length	265 m
Distance To Break	1 m
Relative Aperture	0.2 fraction
Pumped Inflow	150 kg/s
Use Ambient Temperature	Use ambient temperature

Vessel/Tank

Duration of Interest	300 s
Method Used for Time Varying Releases	Average Rates

Location

[Elevation	1 m]
Concentration of Interest	2.2E4 ppm
Averaging time associated with Concentration	Flammable
Distances for Radiation Modeling and Dispersion Scope(1)	50 m
Distances for Radiation Modeling and Dispersion Scope(2)	250 m
Distances for Radiation Modeling and Dispersion Scope(3)	500 m
Use ERPG averaging time	ERPG not selected
Use IDLH averaging time	IDLH not selected
Use STEL averaging time	STEL not selected
Supply a user defined averaging time	Not supplied

Bund

Status of Bund	No bund present
[Type of Bund Surface	Concrete]
[Bund Height	0 m]
[Bund Failure Modeling	Bund cannot fail]

Indoor/Outdoor

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Study Folder: 70977-Fase 2-Ip15

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Location of release	Open air release
Outdoor Release Direction	Horizontal
Flammable	
Explosion Method	TNT
Jet Fire Method	API Model
Dispersion	
Late Ignition Location	No ignition location
Fireball Parameters	
[Mass Modification Factor	3]
[Calculation method for fireball	DNV Recommended]
[TNO model flame temperature	1727 degC]
Toxic Parameters	
[Indoor Calculations	Unselected]
[Wind Dependent Exchange Rate	Case Specified]
[Building Exchange Rate	4 /hr]
[Tail Time	1800 s]
[Set averaging time equal to exposure time	Use a fixed averaging time]
[Cut-off fraction of toxic load for exposure time calculation	0.05 fraction]
[Cut-off concentration for exposure time calculations	0 fraction]
Geometry	
Shape	Point
Dimension	2D
System	Absolute
East(1)	0 m
North(1)	0 m

Path: \70977-Fase 2-Ip15\Misura Fiscale - Erogazione\140mm

Discharge Data

User-Defined Quantities

Material	METHANE
Temperature	25,00 degC
Pressure	71,01 bar
Inventory	14.000,00 kg
Scenario	Long Pipeline
Fixed Duration	n/a s

Calculated Quantities

Weather: Global Weathers\Category 2/F

Mass Flow of Air (Vent from Vapor Space Only) n/a

Average Values for Segment Number 1

Liquid Fraction	0,00 fraction
Final Temperature	-1,82 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um

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Study Folder: 70977-Fase 2-Ip15

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Continuous Release Data:

Mass Flowrate	1.83558E+002 kg/s
Release Duration	300,00 s
Orifice Velocity	n/a m/s
Exit Pressure	n/a bar
Exit Temperature	n/a degC
Discharge Coefficient	n/a
Expanded Radius	n/a m

Weather: Global Weathers\Category 5/D

Mass Flow of Air (Vent from Vapor Space Only) n/a

Average Values for Segment Number 1

Liquid Fraction	0,00 fraction
FinalTemperature	-1,82 degC
Final Velocity	500,00 m/s
Droplet Diameter	0,00 um

Continuous Release Data:

Mass Flowrate	1.83558E+002 kg/s
Release Duration	300,00 s
Orifice Velocity	n/a m/s
Exit Pressure	n/a bar
Exit Temperature	n/a degC
Discharge Coefficient	n/a
Expanded Radius	n/a m

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP15

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Consequence Results

Distance to Concentration Results

Path: \70977-Fase 2-IP15\Misura Fiscale - Erogazione\140mm

The height for user defined concentrations is the user defined height 0 m

All toxic results are reported at the toxic effect height 0 m

All flammable results are reported at the cloud centreline height

Concentration(ppm) Averaging Time				Distance (m)	
				Category 2/F	Category 5/D
User Conc (22000)	18.75	s		124.031	164.274
UFL (165000)	18.75	s		46.9284	40.3359
LFL (44000)	18.75	s		150.639	157.764
LFL Frac (22000)	18.75	s		205.617	210.036
Concentration(ppm) Averaging Time				Heights (m) for above distances	
				Category 2/F	Category 5/D
User Conc (22000)	18.75	s		0	0
UFL (165000)	18.75	s		1.78534	1.26492
LFL (44000)	18.75	s		22.7663	13.1685
LFL Frac (22000)	18.75	s		39.931	21.5784

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP15

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Concentration At Distance Results

Path: \70977-Fase 2-IP15\Misura Fiscale - Erogazione\140mm

The height for user defined concentrations is the user defined height 0 m

All toxic results are reported at the toxic effect height 0 m

All flammable results are reported at the cloud centreline height

Distance		Conc.(ppm) at Flammable Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	157543	143019
250	m	14574.2	15582.7
500	m	3997.36	3956.03

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	1.91244	1.47382
250	m	51.5505	27.0735
500	m	93.3695	51.2278

Distance		Conc.(ppm) at Core Avg. Time of 18.75 s	
		Category 2/F	Category 5/D
50	m	157543	143019
250	m	14574.2	15582.7
500	m	3997.36	3956.03

Distance		Heights (m) for above concentrations	
		Category 2/F	Category 5/D
50	m	1.91244	1.47382
250	m	51.5505	27.0735
500	m	93.3695	51.2278

Jet Fire Hazard

Path: \70977-Fase 2-IP15\Misura Fiscale - Erogazione\140mm

Jet fire method used: API

		Category 2/F	Category 5/D
Jet Fire Status		Hazard	Hazard
Flame Direction		Horizontal	Horizontal

Radiation Effects: Jet Fire Ellipse

Path: \70977-Fase 2-IP15\Misura Fiscale - Erogazione\140mm

This table gives the distances to the specified radiation levels for each jet fire listed in the above hazard table

			Distance (m)	
			Category 2/F	Category 5/D
Radiation Level	12.5	kW/m2	191.865	191.865
Radiation Level	7	kW/m2	200.213	200.213
Radiation Level	5	kW/m2	205.927	205.927
Radiation Level	3	kW/m2	216.966	216.966

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP15

Unique Audit Number: 65.808

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Radiation Effects: Jet Fire Distance

Path: \70977-Fase 2-IP15\Misura Fiscale - Erogazione\140mm

			Radiation Level (kW/m2)	
			Category 2/F	Category 5/D
Distance Of Interest 50	m		Engulfed	Engulfed
Distance Of Interest 250	m		1.02928	1.02928
Distance Of Interest 500	m		0.0752325	0.0752325

Flash Fire Envelope

Path: \70977-Fase 2-IP15\Misura Fiscale - Erogazione\140mm

All flammable results are reported at the cloud centreline height

			Distance (m)	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	205.617	210.036
Furthest Extent	44000	ppm	150.639	157.764
			Heights (m) for above distances	
			Category 2/F	Category 5/D
Furthest Extent	22000	ppm	39.931	21.5784
Furthest Extent	44000	ppm	22.7663	13.1685

SUMMARY REPORT

Study Folder: 70977-Fase 2-IP15

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Explosion Effects: Late Ignition

Path: \70977-Fase 2-IP15\Misura Fiscale - Erogazione\140mm

Explosion Model Used : TNT

Explosion Location Criterion: Cloud Front (LFL Fraction)

All distances are measured from the Source

All flammable results are reported at the cloud centreline height

			Maximum Distance (m) at Overpressure Level	
			Category 2/F	Category 5/D
Overpressure	0.02068	bar	555.996	533.576
Overpressure	0.1379	bar	292.176	293.782
Overpressure	0.2068	bar	271.324	274.829

			Supplementary Data at 0.02068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		1157.72	869.355
Used Flammable Mass	kg		1157.72	869.355
Overpressure Radius	m		355.996	323.576
Distance to:				
- Ignition Source	m		200	210
- Cloud Front/Centre	m		200	210
- Explosion Centre	m		200	210

			Supplementary Data at 0.1379 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		1157.72	869.355
Used Flammable Mass	kg		1157.72	869.355
Overpressure Radius	m		92.1762	83.7819
Distance to:				
- Ignition Source	m		200	210
- Cloud Front/Centre	m		200	210
- Explosion Centre	m		200	210

			Supplementary Data at 0.2068 bar	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		1157.72	869.355
Used Flammable Mass	kg		1157.72	869.355
Overpressure Radius	m		71.3238	64.8285
Distance to:				
- Ignition Source	m		200	210
- Cloud Front/Centre	m		200	210
- Explosion Centre	m		200	210

			Overpressures (bar gauge) at Distances	
			Category 2/F	Category 5/D
Distance	50	m	1	1
Distance	250	m	0.369718	0.459352
Distance	500	m	0.0256443	0.0236937

			Supplementary Data at 50 m	
			Category 2/F	Category 5/D
Supplied Flammable Mass	kg		102.545	82.013

SUMMARY REPORT

Study Folder: 70977-Fase 2-Ip15

Unique Audit Number: 65.808

Phast 6.6



Used Flammable Mass	kg	102.545	82.013
Supplementary Data at 250 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	1157.72	869.355
Used Flammable Mass	kg	1157.72	869.355
Supplementary Data at 500 m			
		Category 2/F	Category 5/D
Supplied Flammable Mass	kg	1157.72	869.355
Used Flammable Mass	kg	1157.72	869.355

Weather Conditions

Path: \70977-Fase 2-Ip15\Misura Fiscale - Erogazione\140mm

		Category 2/F	Category 5/D
Wind Speed	m/s	2	5
Pasquill Stability		F	D
Surface Roughness Length	mm	1000	1000
Surface Roughness Parameter		0.173718	0.173718
Atmospheric Temperature	degC	25	25
Surface Temperature	degC	25	25
Relative Humidity	fraction	0.75	0.75